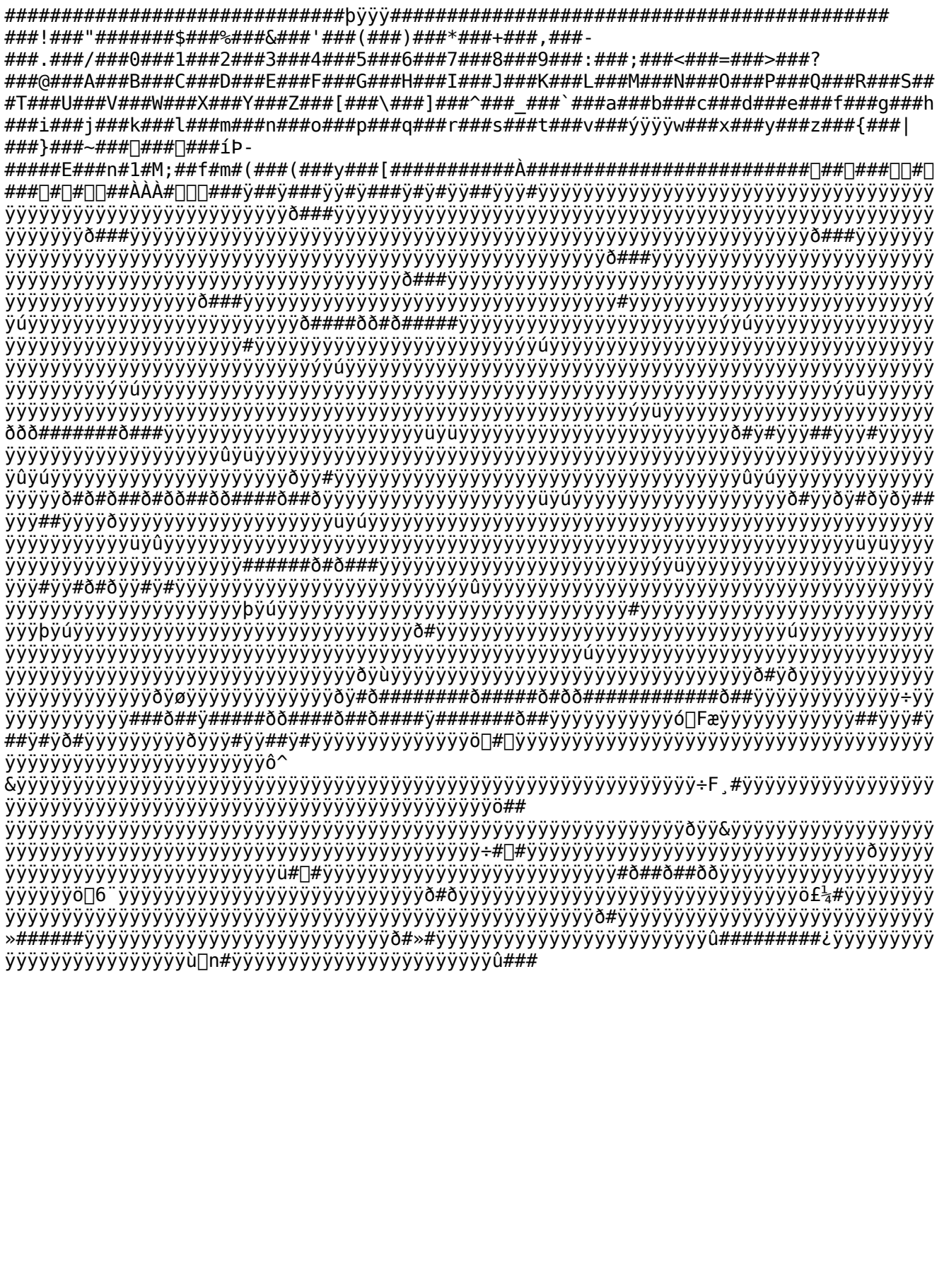

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ã### ##########ÿ□#ÿÿd#########d#-#######□###A Brief given at Woods Hole
Oceanographic InstitutionbyDr. F. E. SaalfeldDeputy Chief of Naval Research
Technical Directorwww.onr.navy.mil

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<#ÿÿ####ÿÿ#####ÿ□#ÿÿd#########d#2####□##õ###Retain the historic connection to high quality world-class foundation researchVertically integrate S&T (6.1, 6.2, & 6.3) Move DoN S&T Program closer to the customer (warfighter) Bridge the gap between short term needs and long term commitments#

###ÿÿ#####ÿ□#ÿÿd#########d#########õ###I would like to spend our remaining time showing you how ONR works to support the Navy now and in the future.We recognize that there is an ambitious technical agenda laid out for the Navy into the next century. To reach these technology levels, requires a clear vision, commitment and aggressive goals. You have seen the last three bullets before, but the concept of time sensitive option generation and development is reaching a new stage of importance..ONR develops technology options. Experience has shown that if technology exists, it will be exploited, by somebody. ONR accumulates knowledge so that later we can exercise the option. Some options we develop you will shelve after completion... a cost of working in an uncertain future. But options must be explored to keep us ahead of the commercial market for weapons, communications, surveillance data and so on. Finally, (and related to bullet four), there is a continuing expansion of the pool of knowledge available to any interested customer.#

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þÿÿ####ÿÿ#####ÿ¥#ÿÿd#########d#2#######Q###Naval S&Tgiving DON the right to
exercise and test options in our future#

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¯#ÿÿ####ÿÿ#####ÿ□#ÿÿd#########d#2#######;###As the future becomes more uncertain,
options grow in valuep
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#####d#########r##□##ªöÍøV   cûÿÿ,###ÿÿ#####ÿ□#ÿÿd#########d##############Forming
Critical Mass for S&Tm
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U#ÿÿ####ÿÿ#####ÿ□#ÿÿd#########d#########>###C4I Systems for us to pass info to
joint &coalition partners
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súÿÿ,###ÿÿ#####ÿ□#ÿÿd#########d#############Future Naval Capability Options#

###ÿÿ#####ÿ□#ÿÿd#########d############# The key to option development is time sensitivity. It does little good to have technology available that is not in a window of system application. there are constantly windows open now. I will show in a few slides how ONR responds to CINC requests for technology now.The classic linear development model (basic research - applied research - advanced development - system acquisition) which still applies in some cases channels our work into SYSCOMS and PEOs for introduction and development in current acquisitions.An emerging trend for ONR is the transfer of technology to industry (which, by the way, is also seeking to leverage ONR for basic research ideas). The knowledge, prototypes, techniques and skills we develop are picked-up, institutionalized and returned to the SYSCOMS included in Industry responses to RFPs.One recent example is the laser line scanner now being used to detect and identify mines. Another is a material known as discontinuously reinforced aluminum pioneered at ONR is now available in bulk at low cost for naval applications because Pratt & Whitney picked up the technology from us and used it in their engines.#Our task is to balance the available investment against the immediate needs of this year and the FYDP against the future needs over the long term.For the Navy, ONR is the active, motivated entrepreneur gathering, discovering, integrating the knowledge we need to stay ahead beyond the FYDP.#In a technological, connected and uncertain world, our rule emulates that of the French Foreign Legion: #Stay ahead or die.þ

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<#ÿÿ####ÿÿ#####ÿ□#ÿÿd#########d#2####□##õ###Retain the historic connection to high quality world-class foundation researchVertically integrate S&T (6.1, 6.2, & 6.3) Move DoN S&T Program closer to the customer (warfighter) Bridge the gap between short term needs and long term commitments#

###ÿÿ#####ÿ□#ÿÿd#########d#########õ###I would like to spend our remaining time showing you how ONR works to support the Navy now and in the future.We recognize that there is an ambitious technical agenda laid out for the Navy into the next century. To reach these technology levels, requires a clear vision, commitment and aggressive goals. You have seen the last three bullets before, but the concept of time sensitive option generation and development is reaching a new stage of importance..ONR develops technology options. Experience has shown that if technology exists, it will be exploited, by somebody. ONR accumulates knowledge so that later we can exercise the option. Some options we develop you will shelve after completion... a cost of working in an uncertain future. But options must be explored to keep us ahead of the commercial market for weapons, communications, surveillance data and so on. Finally, (and related to bullet four), there is a continuing expansion of the pool of knowledge available to any interested customer.

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Wûÿÿ ###ÿÿ#####ÿ□#ÿÿd#########d#########A###To Achieve This Vision,# ONR Focuses
Environmental Investmeny on:s
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s#ÿÿ ###ÿÿ#####ÿ□#ÿÿd#########d#############Understanding ocean, atmosphere & air-sea processesLearn how to simulate & predict those processesBe able to determine affect of processes on operations, people, sensors & our big machinesRapid characterization & adaption ....that is good enough

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##ÿÿ####ÿÿ#####ÿ□#ÿÿd#########Z######□##z###□Pull□ (DON needs and problems)
Air/Ocean/Ice On-Scene Prediction models (especially littoral, usable for training
and simulation)Small-scale understanding/characterization supporting MIW/MCM,
ExpWar, NSWDeployable, real-time in situ sensors, fused with remote-sensing data
Knowledge of space/time variability of ocean bottom topography and beach areas
□Push□ (S&T opportunities)Autonomous and networked systemsAEGIS Tactical weather
radarHyperspectral SensingCoastal and Open Ocean Observational TechniquesRegional
Scale Coastal and Open Ocean Prediction SystemsEnvironmentally adaptive
capabilities for naval systems/sensors
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□#ÿÿ####ÿÿ#####ÿ□#ÿÿd#########d######□## ###Strategy elementsThe littoral region, as the expected battlespace of future operations, will continue to receive emphasisrelocatable ocean/atmosphere models, on-scene observations, and on-board prediction abilityIncreased focus on small-scale processes and related applications because of their prominent role in MCM, AmW, NSW in littoral operationsinvolves environmental issues in optics, acoustics, electromagnetics, hydrodynamics, biology/chemistry, geology/geo technologyBSE will be a leader in bringing the national resources to bear on the most pressing issues in Naval oceanographymaintain strong support of the academic communityNOPP is mechanism for increased interagency discussion and cooperationContinue to develop stronger ties to BSE major customer (N096)#

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D#ÿÿ####ÿÿ#####ÿ□#ÿÿd#########d######□######Thrusts/Technical ChallengesPredictive Systemsdevelop ocean and atmospheric observations and models that provide predictive ability to the on-scene commander, with special emphasis on the littoral zonedevelop advanced wave prediction methods and radiative transfer models for visibility in the ocean and atmosphereLarge Scale Processesdevelop understanding/characterization of the large scale processes in the ocean and atmosphere that control the overall setting in which most naval operations occur Small Scale Processesdevelop understanding/characterization of small scale processes that affect systems (acoustic, optical, electromagnetic/electro-optic, gravity and magnetic)coastal hydrodynamic processes and fluid/structure interactionsSensors/Dataatmospheric and oceanic observations at high resolution in denied areasQuantify Role of Environment on Systems (jointly)determine for all warfare areas the most critical environmental dataquantify impact of environmental data in all warfare areasNational Ocean Partnership Program

###ÿÿ#####ÿ□#ÿÿd#########d#########X###Predictive Systems - global/regional/local ocean & coastal models, ocean waves, data assimilation methods, on-scene atmospheric forecasts, radiative transfer models, coupled ocean-atmosphere models, coastal ocean prediction, predictabilityLarge Scale Processes - mesoscale oceanography, ocean subbottom profiling, tropical cyclone structure, coastal meteorologySmall Scale Processes - marine boundary layer, wave processes, biological link to physical processes, internal waves, wave-driven flows, coastal aerosols, flow/structure interaction, arctic processes, atmos. influences on EM/EO, littoral optics, volume acoustic coherence, biosensors, linkage to large scaleSensors/Data - envir. sensors for UUVs, autonomous ocean sampling, tactical radar, atmospheric environmental networks, acoustic doppler profiler (horiz currents), acoustic sediment concentration profilers, wave boundary layer profilers, optical sensors, biological sensors, arctic process sensors, tidal sensors, METOC data, hyperspectral sensingQuantify Role of Environment on Systems - biology in MCM, s/w acoustics, real-time targeting, E/M for MCM, torpedo acoustics, optics for MCM, ocean data for MCM, env. adaptive systemsNational Ocean Partnership Program - distributed ocean & sensing data systems, autonomous observational technologies, relocatable coastal prediction, education, Medea

ûÌÿÆ#ÿÿ####ÿÿ#####ÿ□#ÿÿd#########d#########-###Predictive Systems - global/regional/local ocean models, ocean waves, data assimilation methods, on-scene atmospheric forecasts, radiative transfer models, coupled ocean-atmosphere models, coastal ocean prediction#Large Scale Processes - mesoscale oceanography, ocean subbottom profiling, tropical cyclone structure, coastal meteorologySmall Scale Processes - marine boundary layer, wave processes, biological link to physical processes, internal waves, wave-driven flows, coastal aerosols, flow/structure interaction, arctic processes, atmos. influences on EM/EO, littoral optics, volume acoustic coherence, biosensorsSensors/Data - envir. sensors for UUVs, autonomous ocean sampling, tactical radar, atmospheric environmental networks, acoustic doppler profiler (horiz currents), acoustic sediment concentration profilers, wave boundary layer profilers, optical sensors, biological sensors, arctic process sensors, tidal sensors, METOC dataQuantify Role of Environment on Systems - biology in MCM, s/w acoustics, ORCA, warfare effectiveness, real-time targeting, E/M for MCM, torpedo acoustics, optics for MCM, ocean data for MCM, geotechnology for MCMNational Ocean Partnership Program - distributed ocean & sensing data systems, autonomous observational technologies, relocatable coastal prediction, education, Medea#

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□ùÿÿ####ÿÿ#####ÿ□#ÿÿd#########d#########J###Big □O□ Environments Focus Area
#Evolution of Thrusts/Technical Challenges

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      súÿÿ$###ÿÿ#####ÿ□#ÿÿd#########d#########1###The Next Thirty Years#(The
Second Step 2013-2028)#
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###2##□##ªö□üV   s#ÿÿ####ÿÿ#####ÿ□#ÿÿd#########d#############No-One Knows if Global Politics Calls for:1 or 2 Medium Scale Regional ConflictsLarge Scale ConflictFew to Many Humanitarian or Peacekeeping ActionsOr Some Combination of the AboveThe Fleet and Marine Corps Must be AgileCapable to Carry Out Whatever Mission Arisesd

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###ÿÿ#####ÿ□#ÿÿd#########d#########ø###Beginning of the □Navy after Next□DD 963, AEGIS Gone - or Very AgedMore than Half of Nimitz Class CVN RetiredBurke Class and LHX at Mid-lifeNSSN, DD 21 Construction CompleteCVX Improvements UnderwayF/A 18E/F, V22, Common Support AircraftAAAV

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#ÿÿ####ÿÿ#####ÿ□#ÿÿd#########d#############Why □Grand Challenges?□a strategy to
provide long-term focusWhat are □Grand Challenges□a steady, achievable view of the
futurehigh-level objectives that have some risk, someexcitement, some motivational
valueKey Characteristicsunambiguouscompellingboldbroad and integrating

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□üÿÿ####ÿÿ#####ÿ□#ÿÿd#########d#########È###Grand Challenges: the end result of a seriesof sequential and concurrent ONR efforts,increasingly focused, each building on previous work.   Intermediate Naval productsare also generated (arrows).

#################,##########################ÿ□#ÿÿd#########d#########2##□###öûF ó#ÿÿ####ÿÿ#####ÿ□#ÿÿd#########d#############Good/Excellent ExamplesPut a man on the moon by the end of the decade...Be Number One in our industry.Make our rivers again safe to fish in.Bad/Poor ExamplesGo boldly where no man has gone before.To understand the ocean.To make the oceans transparent.To predict climate.e

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øÆ#ãùÿÿ$###ÿÿ#####ÿ□#ÿÿd#########d#########9###ONR Oceanography Grand
Challenges#Environmental Dominance

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□#ÿÿ####ÿÿ#####ÿ□#ÿÿd#########d#########□###Provide Maritime Intelligence,
Surveillance &               Reconnaissance (ISR) on DemandEnvironmentally
Adaptive Sonar Systems; cost effective, self optimizedOwning the Environment;
Knowledge of the current& future environment, including effects on systems and
tacticsSubsea Littoral Adaptive Presence that can be monitored & controlled
remotely from Web-like site (networked autonomous systems)Expanded Engagement
Envelope: a.k.a. Torpedo Shield; submarine detection & classification distances
that are twice the range of torpedoesAssured Unimpeded Movement from Sea to Shore;
amphibious assualts at full operational tempo in all environments#
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#####Z#########2##□##âü#úþ#{üÿÿ####ÿÿ#####@ÿ□#ÿÿd#########n#########}###1. Mine
Countermeasures 2.  Littoral Information Superiority3. Project and Sustain Forces
Ashore4. Environmental Dominance#
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A superior ability to forecast weapons, surveillance and assualt systems□ performance can provide □windows□ of large relative advantage for the tactical decision maker. This ownership of the battlespace environment will enhance operational strengths while mitigating weaknesses. The key is a real-time forecast that resolves tactically important scales in the battlespace and that assimilates/fuses in situ and remote sensed data. Improved capability could lead to techniques that shape or control certain aspects of the operational systems□ environment for tactical advantage (e.g. locally controlled wave motions or aerosol distributions).#

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Ç#ÿÿ####ÿÿ#####ÿ□#ÿÿd#########_#########´###MPP Computational Fluid Dynamics
algorythmsHigh bandwidth data communications In situ autonomous sensing system
Databases & management of large, archivesData fusion algorythms
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##ÿÿ####ÿÿ#####ÿ#ÿÿd#########_#########i###Supporting TechnologiesReal-time 3D
littoral environment nowcast & forecastStochastic acoustic field characterization
(biota, internal    waves, finestructure...) to design & operate coastal sonars
Spaceborne & airborne systems to measure & infer       surface and subsurface
parameters (e.g. water clarity,       surface waves, stratification, bathymetry).#
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###ÿÿ####Aÿ□#ÿÿd#########F#########Î###Related National/International Programs
Program   AgencyWeather forecasting - US Coast   NOAA   Observational (in
situ) systems/networksCoastal geomorphology   USGS & MMSCoastal physical
oceanography   NSF

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###ÿÿ####Aÿ□#ÿÿd#########F#########□###  Current Naval Program   6.1   6.2   6.3
Coastal dynamics     ü Open ocean waves                                   üCoastal
meteorology                               üOcean predicition
ü  üAtmospheric prediction                           ü  üComputers
üSensors                                                     ü  ü
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###ÿÿ####Aÿ□#ÿÿd#########F#########·###Technology Gaps/OpportunitiesOrganic sensing systems: RPV, UUV, radar, sonar, expendablesLocal terrain & land surface databasesForecast model for shoaling waves (outside surfzone)e

###ÿÿ####Aÿ□#ÿÿd#########F#########¹###Capability SpecificationContinuous shipboard weather nowcast & forecast throughout the littoral battlespace for tactically relevant scales; forecast accurate TDAs & ETDAs for two days.#

###ÿÿ####Aÿ#ÿÿd#########F#########~###Powerful shipboard computers & displaysData assimilation theory & algorythmsForecast models for open ocean & surfzone waves

###ÿÿ####Aÿ□#ÿÿd#########F#########□###Re-direct & mediate local environment (e.g. visibility, surface wavesShipboard MPP computersRemote sensing (radar, sonar, satellite) & signal processing#

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□úÿÿ####ÿÿ#####ÿ□#ÿÿd#########P#########«###10 db Operational Capability
Improvements#Assured Sustained Littoral Operations#Environmental Dominance# □□□
Real-time 3D Littoral Environment Nowcast & Forecast □□□ #             n
```

###ÿÿ####Aÿ□#ÿÿd#########U##########&###Operational Capability GapLittoral environment nowcasts & forecasts are inadequate for system design, realistic training, doctrine development & tactical decisions.Current observations & predictive models do not account for the high temporal & spatial variability of the littoral environment.

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      □###$###(######ÿ□#ÿÿd#########d#########R###ONR Enables DoN to Capitalize on Technology Knowledge for the □Navy after Next□

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8#ÿÿ####ÿÿ#####ÿ#ÿÿd#########d#########ª###VTOL& jet packsManned satellites100
Knot NavyAdv. NTDSSatellite communicationsPressure fired steamAdvanced 8 inch gun
Beam WeaponsPrecise Timekeeping & Navigation
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      #ûÿÿ####ÿÿ#####ÿ□#ÿÿd#########d#########.###1960 Technology
Perspectives#SECNAV, CNO & CMC
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/gÄ#########Ä#####r##□##êû####ã#ÿÿ####ÿÿ#####ÿ□#ÿÿd#########d#########F###Success depends on continuing dialog and redefinition of the problem.

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      s#ÿÿ####ÿÿ#####ÿ□#ÿÿd#########d#########R###Click to edit Master text styles
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